

We claim:

1. An optical interconnect for an electronic system comprising a plurality of waveguide plates arranged in a stack, a number (n) circuit board assemblies mounted on the stack, redundant power distribution means for each circuit board assembly, the stack of waveguide plates having an aggregate number w of optically isolated transmit and receive waveguide paths, where  $w = ((n) \times (n-1)/(2))$ , each circuit board having a number (n-1) of electro-optical interfaces in optical registry with transmit and receive paths whereby each circuit board assembly communicates with every other circuit board assembly in the system.

2. An optical interconnect for an electronic system comprising a plurality of waveguide plates arranged in a stack, a number (n) circuit board assemblies mounted on the stack, redundant power distribution means for each circuit board assembly, the stack of waveguide plates having an aggregate number w of optically isolated transmit and receive waveguide paths, where  $w = ((n) \times (n-1)/(2))$ , each circuit board having a number (n-1) of electro-optical interfaces in optical registry with transmit and receive paths whereby each circuit board is electrically isolated from every other circuit board assembly in the system.

3. A waveguide plate as defined in claim 2 which is circular to minimize the length of optical paths and thereby to minimize transmission delays.

4. A waveguide plate as defined in claim 2 which is rectilinear.

5. A waveguide plate as defined in claim 2 which is rectilinear and circular.

6. An optical interconnect for an electronic system comprising a plurality of waveguide plates arranged in a stack, a number (n) circuit board assemblies mounted on the stack, redundant power distribution means for each circuit board assembly, the stack of waveguide plates having an aggregate number w of optically isolated transmit and receive waveguide paths, where  $w = ((n) \times (n-1)/(2))$ , each circuit board having a number (n-1) of electro-optical interfaces in optical registry with transmit and receive paths whereby circuit board surface area is minimized for optimum air cooling of the system.

7. A waveguide plate comprising at least one pair of side-by-side optically isolated paths passing through the body with the optical paths being optically accessible at spaced pairs of adjacent optically isolated ports at the surface of the body.

*A*  
*(b)*

8. A waveguide plate as defined in claim 7 in which the paths and ports accommodate transmit and receive optical signals.

9. A waveguide plate as defined in claim 7 in which the paths and ports accommodate transmit and transmit optical signals.

10. A waveguide plate as defined in claim 7 in which the paths and ports accommodate receive and receive optical signals.

11. A waveguide plate for an optical interconnect comprising a plurality of pairs of side-by-side optically isolated transmit and receive paths passing through the body with the optical paths being optically accessible at spaced pairs of adjacent optically isolated receive and transmit ports at the surface of the body.

12. An optical interconnect in the form of a midplane for an electronic system having a plurality of circuit board assemblies with electro-optical interfaces, the interconnect comprising a set of waveguide plates having a plurality of waveguide pairs extending between front and back edges of the plates, the waveguide pairs terminating in optically isolated waveguide ports defining cardguide stations at the front and back

edges, the waveguide plates being stacked with respect to each other and presenting the front and back edges for receiving the electro-optical interfaces of the circuit board assemblies at the cardguide stations.

A) 13. An optical interconnect for an electronic system comprising eight waveguide plates arranged in a stack, eight circuit board assemblies mounted on the stack at 45° stations about the stack, redundant power distribution means for each circuit board assembly, the stack of waveguide plates having four three-pair plates of side-by-side optically isolated transmit and receive paths passing through the body, the three pair of paths in each plate being parallel to each other with one path extending diametrically of the plate between stations, and two paths extending as chords between stations, and the paths being optically accessible at spaced pairs of adjacent optically isolated receive and transmit ports at the stations on the plate the stack of waveguide plates further having four four-pair of side-by-side optically isolated transmit and receive paths passing through the body, the four pair of paths being parallel to each other and extending as chords between stations, and the paths being optically accessible at spaced pairs of adjacent optically isolated receive and transmit ports at the stations on the plate thereby providing an aggregate of twenty-eight optically isolated transmit and receive waveguide paths, each

circuit board having seven of electro-optical interfaces in optical registry with transmit and receive paths whereby each circuit board assembly communicates with every other circuit board assembly in the system.

14. An optical interconnect for an electronics system comprising a plurality of waveguide plates arranged in a stack, a number ( $n$ ) of circuit board assemblies mounted on the stack at spaced stations, redundant power distribution means for each circuit board assembly, the stack of waveguide plates having a number  $(n/2)$  of  $(n-2)/2$ -pair plates of side-by-side optically isolated transmit and receive paths passing through the body, and the paths being optically accessible at spaced pairs of adjacent optically isolated receive and transmit ports at the stations on the plate; the stack of waveguide plates further having a number  $((n)/(2))$  of  $(n)/2$ -pair of side-by-side optically isolated transmit and receive paths passing through the body, the paths being optically accessible at spaced pairs of adjacent optically isolated receive and transmit ports at the stations on the plate thereby providing an aggregate number  $((n)\times(n-1)/(2))$  of optically isolated transmit and receive waveguide paths, each circuit board having a number  $(n-1)$  of electro-optical interfaces in optical registry with transmit and receive paths whereby each circuit board assembly communicates with every other circuit board assembly in the system.

*(A)*  
*(o)*  
15. An optical interconnect as defined in claim 14 in which the waveguide plates are circular.

16. An optical interconnect as defined in claim 14 in which the waveguide plates are rectilinear.

17. An optical interconnect as defined in claim 14 in which the waveguide plates are rectilinear and circular.

18. A waveguide plate for an optical backplane comprising at least one pair of side-by-side optically isolated transmit and receive paths passing through the body with the optical paths being optically accessible at spaced pairs of adjacent optically isolated receive and transmit ports at the surface of the body, the receive and transmit ports being recesses defining positive locating means for an electro-optical interface and for receiving another set of waveguides to extend the optical paths directly onto a circuit board assembly.

19. An optical interconnect in the form of a midplane for an electronic system having a plurality of circuit board assemblies with electro-optical interfaces, the interconnect comprising rectilinear and circular midplane sections, the rectilinear section having front and back edges and a concave circular edge interconnecting the front and back edges, the

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rectilinear sections defining a set of waveguide plates having a plurality of waveguide pairs extending between front, back and circular edges of the plates, the circular sections defining a set of waveguide plates having a plurality of waveguide pairs extending between circular edges of the plates, the rectilinear and circular sections being nested with the circular sections abutting the concave edge of the rectilinear sections, the waveguide pairs of rectilinear and circular sections terminating in optically isolated waveguide ports defining cardguide stations at the front, back, and circular edges, the waveguide plates being stacked with respect to each other and presenting the front, back and circular edges for receiving the electro-optical interfaces of the circuit board assemblies at the cardguide stations.

20. An optical backplane to provide communications paths for electronics systems with electro-optical interfaces, the backplane comprising a plurality of waveguide plates having at least one pair of side-by-side optically isolated transmit and receive paths passing through the plates with the optical paths being optically accessible at spaced pairs of adjacent optically isolated receive and transmit ports at the surface of the plates, the receive and transmit ports defining means for receiving electro-optical interfaces whereby a fully redundant backplane fits in electronic systems so that an additional set of

communications paths is available should an electronics system communications path in use fail.

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21. An optical interconnect for an electronic system having any number of circuit board assemblies, the interconnect comprising at least one waveguide plate in the form of an opaque body having three pair of side-by-side optically isolated transmit and receive paths passing through the body, and at least one waveguide plate in the form of an opaque body having four pair of side-by-side optically isolated transmit and receive paths passing through the body.

22. An optical interconnect for an electronic system having any number of circuit board assemblies, the interconnect comprising a plurality of stacked waveguide plates having internal, optically isolated communication paths accessible at the surface of the plates to any number of circuit board assemblies, the waveguide plate stack having an end surface to which additional waveguide plates may be added for serving new circuit board assemblies added to the system thereby to upgrade the system without the need for a forklift upgrade.